# EXHIBIT 2

**IN THE UNITED STATES DISTRICT COURT**
**FOR THE DISTRICT OF NEW JERSEY**

| | | |
|---|---|---|
| **LEXINGTON LUMINANCE LLC,** | § | |
| | § | |
| ***Plaintiff*,** | § | |
| | § | |
| **v.** | § | **Civil Action No. 2:22-cv-03787-JMV-JSA** |
| | § | |
| **BULBRITE INDUSTRIES, INC.,** | § | **JURY DEMANDED** |
| | § | |
| ***Defendant*.** | § | |
| | § | |

**DECLARATION OF EDWIN L. PINER, PhD.**

## I. INTRODUCTION

I, Edwin L. Piner, hereby certify pursuant to 28 U.S.C. § 1746 that:

1. I have been engaged by counsel for Plaintiff Lexington Luminance LLC ("Lexington") in the above-captioned matter to provide my opinions with respect to U.S. Patent No. 6,936,851 ("the '851 patent"). I submit this Declaration in support of Lexington's Second Amended Complaint. I make this declaration based on my personal knowledge and, if called as a witness, could and would competently testify thereto.

## II. EXPERIENCE AND QUALIFICATIONS

2. I am currently a Professor of Physics and Materials Science, Engineering, and Commercialization at Texas State University, where I have been a faculty member since 2010. From 2000 to 2009, I was Director of Advanced Technology at Nitronex Corporation in Durham, North Carolina, where I worked extensively in GaN-based electronic and photonic devices. From 1998 to 2000, I was a Research Engineer at ATMI Corporation's Epitronics subsidiary in Phoenix, Arizona, where I worked on GaN-based electronic materials.

3. My principle areas of research have included GaN and related materials (group III nitrides) for light emitting diodes, laser diodes and heterojunction field effect transistors. I have

been involved in, and directed, research concerning III-nitride material growth processes on sapphire, silicon carbide, silicon, and bulk AlN using metalorganic chemical vapor deposition (MOCVD) and related technologies. During 1994-1997, I performed extensive investigations into the nucleation and growth of GaN by MOCVD on sapphire with special emphasis on the substrate nucleation process through experiments with atomic layer epitaxy and molecular stream epitaxy. Thus, through my education, experience, and training, in academia and industry, I have expertise in the field of the '851 Patent.

4. I am a Senior Member of the Institutes of Electrical and Electronic Engineers, member of the Materials Research Society, Electrochemical Society, and international advisory committees for two annual conferences and workshops. I have published over 100 peer-reviewed papers related to III-nitride research and development. I am a named inventor on 32 U.S. patents. I have received a number of honors and awards for my work in group III-nitride technology and been invited to speak on several occasions regarding my group III-nitride research.

5. I have become familiar with the properties of crystal structures through my work with semiconductor materials, processes, and devices over the past 25+ years. Through my past employment, I have personally observed crystal structures under various conditions, at various magnifications, and through using various instrumentations. I am a trained microscopist and have extensive experience with (Scanning) Transmission Electron Microscopy ("(S)TEM"), including fundamentals of the technique, sample preparation, sample characterization and data analysis. I have utilized the techniques throughout the past 25 years for characterizing semiconductor materials and structures; principally GaN and related materials. My experience includes direct "hands-on" interactions with the equipment, the samples (including preparation

and characterization) and analysis of the microscopy data, including peer-reviewed publications of (S)TEM results concerning GaN.

6. A more complete list of my qualifications is set forth in my curriculum vitae, a copy of which is attached hereto as Exhibit A.

7. I am being paid $400 per hour for my work in this matter. My compensation in no way depends on the outcome of this litigation nor do I have a personal interest in the outcome of this litigation.

## III. BACKGROUND

8. I have reviewed the ’851 patent. In my opinion, it relates generally to the field of fabrication of semiconductor devices such as light-emitting devices in lattice-mismatched misfit systems.

9. I have been informed and understand that Lexington has accused Defendant of infringing claim 1 of the ‘851 patent.

10. Claim 1 of the as-reexamined ‘851 patent states as follows:

> A semiconductor light-emitting device comprising:
>
> a substrate;
>
> a textured district defined on the surface of said substrate comprising a plurality of etched trenches having a sloped etching profile with a smooth rotation of microfacets without a prescribed angle of inclination;
>
> a first layer disposed on said textured district, comprising a plurality of inclined lower portions, said first layer and said substrate form a lattice-mismatched misfit system, said substrate having at least one of a group consisting of group III-V, group IV, group II-VI elements and alloys, ZnO, spinel and sapphire;
>
> and a light-emitting structure containing an active layer disposed on said first layer, whereby said plurality of inclined lower portions are configured to guide extended lattice defects away from propagating into the active layer.

11. Lexington has provided to me samples of LEDs which, I understand and have been informed, are from the Bulbrite 772832 LED9BR30/940/D BR30 9W LED 4000K E26 lighting product (an exemplary "Accused Device"). I analyzed the LEDs from the Accused Device as described below.

## IV. OPINIONS

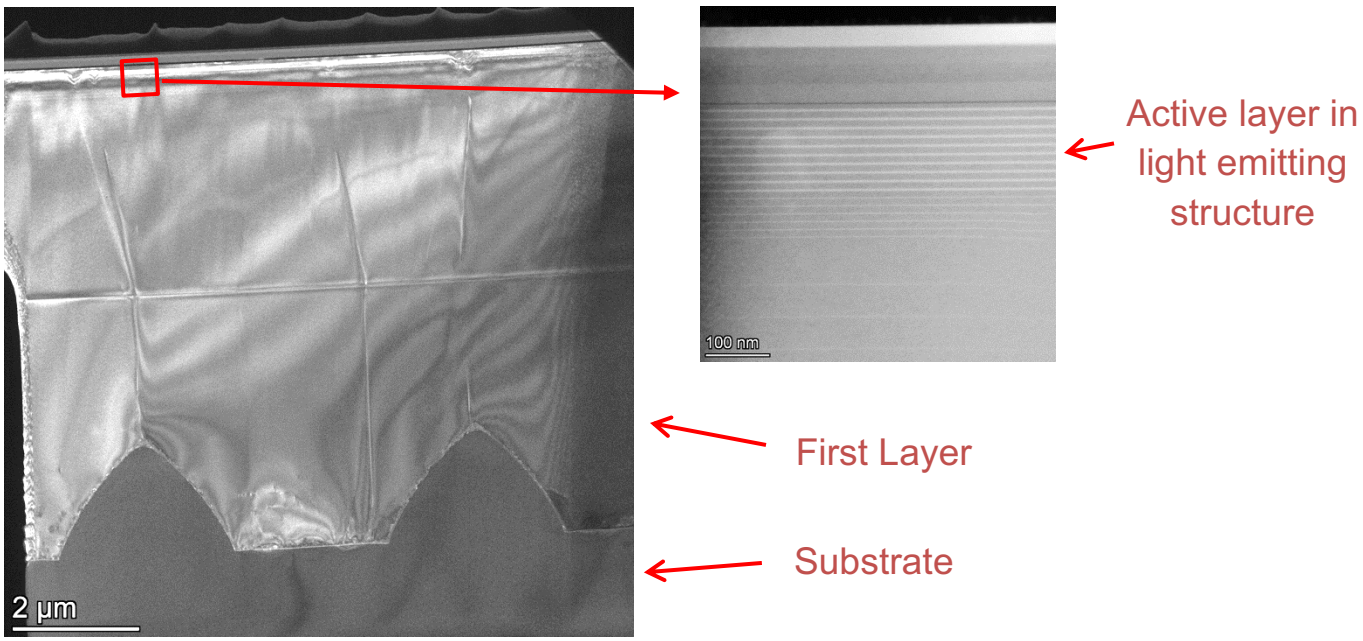
### A. The Accused Device Contains "an active later disposed on [the] first layer"

12. For the reasons described below, it is my opinion that the LEDs in the Accused Device contain "an active later disposed on [the] first layer."

13. The active layer in an LED is the layer that emits the light.

14. My analysis of the Accused Device includes Transmission Electron Microscopy ("TEM") characterization of the trenches with etched slopes that form the sapphire substrate surface. TEM is well suited for detailed crystal structure analysis because of the ability to image features down to 0.1 nanometer (nm) under high resolution, or roughly the diameter of one atom. I viewed the etched sloped sides of the trenches in outline from the side, i.e., in cross-section, by first preparing a thin-foil (< 100 nm thick) sample that was electron transparent and oriented along the apex of the etched trenches. By obtaining samples using this orientation, I was able to view the LED profile in cross-sectional outline from the side. Finally, the sample was mounted on a fixture appropriate for examining by TEM and placed in the TEM instrument wherein various imaging modes facilitate data collection.

15. The TEM results are shown below.



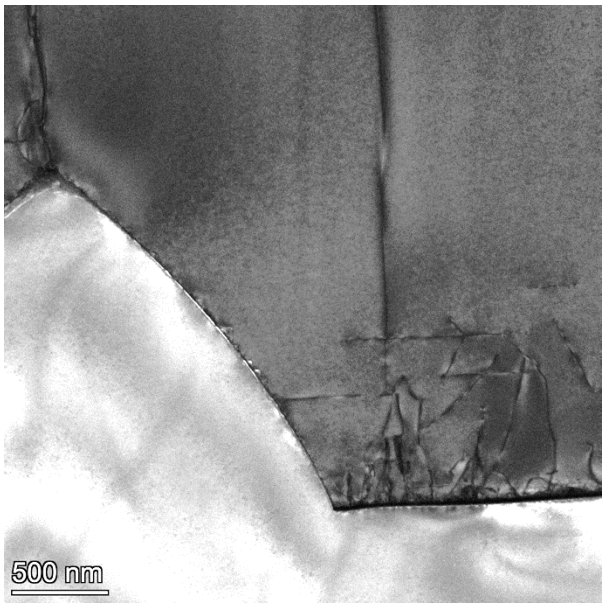

16. For the purpose of systematic comparison, the image on the left shows a lower magnification profile of the LED showing a light-emitting structure containing an active layer disposed on a first layer, and the image on the right shows a higher magnification image of the active layer region. The multi-quantum well active layer appears comprising multiple well layers (with bright contrast) separated by barrier layers (with relatively darker contrast).

**B. The Accused Device meets the limitation "whereby [the] plurality of inclined lower portions are configured to guide extended defects away from propagating into the active layer"**

17. For the reasons described below, it is my opinion that the LEDs in the Accused Device satisfy the limitation "whereby [the] plurality of inclined lower portions are configured to guide extended defects away from propagating into the active layer".

18. The inclined lower portions of the first layer disposed on the textured district used in the Accused Device are configured to guide extended lattice defects away from propagating into the active layer. This reduces the defect density in the upper planar portion of the layers where the light-emitting structure containing an active layer is disposed.

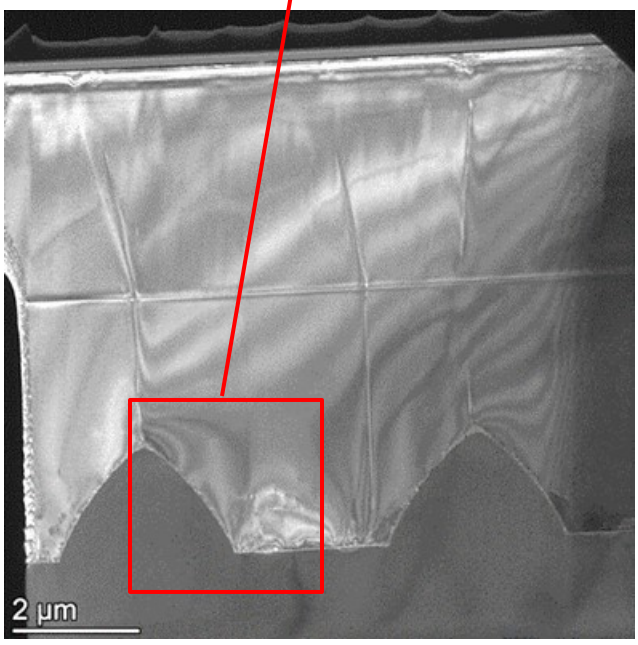
19. As shown in the TEM images below, the inclined lower portions of the first layer disposed on the textured district used in the Accused Device are configured to guide extended lattice defects such as misfit dislocations away from propagating into the active layer. The defect density in the upper planar portion of the layers is reduced as revealed by examining the defect density of the LEDs used in the Accused Products.




First Layer

Many extended lattice defects such as threading and misfit dislocations are guided away from propagating into the active layer

Substrate




Lower defect density in the upper planar portion of the first layer

Higher defect density

20. The defects appearing in the above image are predominately threading dislocation defects.

21. Using my training and experience, and informed by the above images, it is my opinion that the inclined lower portions of the first layer disposed on the textured district used in the Accused Device are configured to guide extended lattice defects away from propagating into the active layer.

**C. The application of a gallium nitride first layer on a sapphire substrate forms a lattice-mismatched misfit system**

22. The application of a gallium nitride first layer on a sapphire substrate forms a lattice-mismatched misfit system. This is due to a large lattice mismatch of approximately fourteen percent. That is, the respective structures of the materials differ, e.g., the lattice constant, of approximately fourteen percent.

23. I have examined the SEM and EDX analysis in Lexington's Second Amended Complaint, and conclude that the LED appearing therein indicates a gallium nitride first layer deposed on a sapphire substrate, based upon the EDX plots.

I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct, and based upon my personal knowledge, and if called upon as a witness, I could and would competently testify thereto.

October 4, 2023
Date

Edwin L. Piner, PhD.

# EXHIBIT A

# TEXAS STATE VITA

## I. Academic/Professional Background

A. Edwin L. Piner, Professor

B. Educational Background

Ph.D., 1998, North Carolina State University, Material Science and Engineering, "*Growth and Characterization of Metalorganic Chemical Vapor Deposition InGaN*"
B.S., 1993, North Carolina State University, Material Science and Engineering

C. University Experience

| *Position* | *University* | *Dates* |
|---|---|---|
| Physics Department Chair | Texas State University | 2023-present |
| Professor | Texas State University | 2013-present |
| Associate Professor | Texas State University | 2010-2013 |
| Visiting Research Professor (Sabbatical) | Padova University, Italy, EU | 2022/07-2023/07 |

D. Relevant Professional Experience

| *Position* | *Entity* | *Dates* |
|---|---|---|
| Founder, CEO | Applied Epitaxial Materials, Inc. | 2013-present |
| Director, Advanced Technology | Nitronex Corporation | 2000-2009 |
| Research Engineer | ATMI Corporation/Epitronics | 1998-2000 |

## II. TEACHING

B. Courses Taught:

MSEC 7401 – Fundamentals of Materials Science and Engineering – Fall 2012 / 2013 / 2014 / 2015 / 2016 / 2017 / 2018 / 2019 / 2020 / 2021
MSEC 7402 – Advanced Materials Science and Engineering Concepts – Spring 2013 / 2014 / 2015 / 2016 / 2017 / 2018 / 2019 / 2020 / 2021 / 2022
MSEC 7312 – Thermodynamics and Kinetics for Material Scientists (as special topic, enabling student to complete, originally taken with Dr. Spencer) – Fall 2017
MSEC 7303 – Research in MSEC (Defects in Group III Nitride Semiconductors and Their Effect on AlGaN/GaN HEMT) – Spring 2016
MSEC 7303 – Research in MSEC (Transmission Electron Microscopy, Theory & Practice) – Fall 2015
MSEC 7303 – Research in MSEC (Microwave & Power Device Physics & Materials) – Spring 2014
PHYS 5404 – Experimental Methods (course coordinator – supported by Drs. Geerts, Holtz, Theodoropolou, Wistey, Zakhidov) – Fall 2017
PHYS 5326 – Electrical Characterization of Materials – Spring 2012
PHYS 5327 – Semiconductor Device Physics – Fall 2018
PHYS 5322 – Semiconductor Device Microfabrication – Fall 2011
PHYS 5100 – Professional Development – Spring 2018
PHYS 1430 – Mechanics – Spring 2010 / Fall 2010 / Spring 2011

C. Graduate Theses/Dissertations, Honors Theses, or Exit Committees:

| | | | |
|---|---|---|---|
| Nelson Simpson | MS Physics | May 2013 | |
| Jon Anderson | MS Physics | June 2014 | Chair/supervisor |
| Hanu Arava | MS Physics | July 2014 | |
| Kunal Bhatnagar | PhD MSEC | June 2015 | |

| | | | |
|---|---|---|---|
| Jeffrey Simpson | PhD MSEC | October 2016 | Chair/supervisor |
| Logan Hancock | PhD MSEC | November 2016 | |
| Lanre Ogedengbe | PhD MSEC | June 2017 | |
| Raju Ahmed | PhD MSEC | March 2018 | Chair/supervisor |
| Peter Walker | MS Physics | March 2018 | |
| Kevin Lyon | MS Physics | April 2019 | |
| Anupam KC | MS Physics | June 2019 | Chair/supervisor |
| Anwar Siddique | PhD MSEC | June 2019 | Chair/supervisor |
| Mehedhi Hasan | PhD MSEC | June 2019 | |
| Andy de la Garza | MS Physics | September 2019 | Co-Chair/supervisor |
| Carol Ellis-Terrell | PhD MSEC | April 2020 | |
| Chhabindra Gautam | MS Physics | April 2020 | Chair/supervisor |
| Jon Anderson | PhD MSEC | June 2020 | Chair/supervisor |
| Joyce Anderson | PhD MSEC | June 2020 | |
| Nischal Khakurel | MS Physics | July 2020 | |
| Rony Saha | PhD MSEC | July 2021 | Co-Chair/supervisor |
| Shamim Reza | PhD MSEC | December 2021 | |
| Anupam KC | PhD MSEC | March 2022 | Co-Chair/supervisor |
| Ganesh Aryal | MS Physics | October 2022 | Chair/supervisor |
| Augustus Arbogast | MS Physics | November 2022 | |
| Tuhin Dey | PhD MSEC | June 2023 | |
| Sadia Rab | PhD MSEC | December 2023 (projected) | |
| Anival Ayala | PhD MSEC | December 2023 (projected) | |
| Daniel Bailey | MS Physics | December 2023 (projected) | Chair/supervisor |
| Biddhut Lamichhane | MS Physics | December 2023 (projected) | Chair/supervisor |
| Binod D.C. | PhD MSEC | December 2023 (projected) | |
| Farah Najdawi | PhD MSEC | May 2024 (projected) | |
| Dipa Devkota | PhD MSEC | May 2024 (projected) | |
| Ganesh Aryal | PhD MSEC | December 2024 (projected) | Chair/supervisor |
| Greg McClendon | MS Physics | | Chair/supervisor |

D. Courses Prepared and Curriculum Development:
MSEC 7402 – Advanced Materials Science and Engineering Concepts – Spring, 2013 (100% new material); a follow-up unique course (partnered with MSEC 7401) designed to give all incoming PhD students a common foundation in materials science and engineering, with advanced topics relative to MSEC 7401.
MSEC 7401 – Fundamentals of Materials Science and Engineering – Fall, 2012 (100% new material) / Fall, 2013; a unique course, compared to other MSE PhD curriculum, designed to give all incoming PhD students a common foundation in materials science and engineering.
MSEC 7303 – Research in MSEC (Microwave & Power Device Physics & Materials) – Spring 2014 (100% new material); a unique self-study course, based on the requests of MSEC graduate students, to develop and understand microwave and power device physics and the materials properties that determine best device operating performance.
Chair – MSEC Curriculum Committee: Giving guidance to departments that desire to establish an effective route for their undergraduates to successfully transition into the MSEC PhD program.
PHYS 5322 – Semiconductor Device Microfabrication – Fall 2011 (75+% new material); completely new lecture materials with emphasis on “real world” application-based device fabrication processes.

PHYS 5327 – Semiconductor Device Physics – Fall 2018 (100% new material); completely new lecture materials focused on advanced texts of semiconductor devices and supplementary materials to round-out a complete study of the topic.
PHYS 5404 – Experimental Methods – Fall 2017 (100% new material); redefined the scope of the course to encompass intensive lab-based exercises, coordinated with five other professors, throughout the semester. Semester reports and final presentation round-out the course evaluation.

**III. SCHOLARLY/CREATIVE**

A. Works in Print (including works accepted, forthcoming, in press)

1. Books

Chapters in Books:

Edwin L. Piner and Mark W. Holtz, "Three-Dimensional Integration of Diamond and GaN". In Marko Tadjer and Travis Anderson (eds.), **Thermal Management of Gallium Nitride Electronics**, Elsevier, July 2022. DOI: 10.1016/B978-0-12-821084-0.00019-6

Don Olson and Edwin L. Piner, "Dating Monet's *Le Port du Havre, Effet de Nuit*". In Géraldine Lefebvre, **Monet au Havre, Les Années Décisives**, Editions Hazan, October 19, 2016. ISBN: 2754108610.

Wayne Johnson and Edwin L. Piner, "GaN HEMT Technology". In S. Pearton (ed.), **GaN and ZnO-based Materials and Devices**, Springer Series in Materials Science, **Vol. 156** (2012). Berlin: Springer-Verlag. DOI: 10.1007/978-3-642-23521-4_7.

2. Articles

a. Refereed Journal Articles:

1. (*Submitted*) "Parasitic RF loss reduction of MOCVD grown AlN/Si by introducing MBE grown AlN layer," Rony Saha, Juan Salvador Rojas-Ramirez, Jonathan Anderson, Mark Holtz and Edwin L. Piner, IEEE Transactions on Microwave Theory and Techniques, ___, ___ (2023). DOI:
2. "Atomic layer deposition of $Al_2O_3$ interlayer for improving AlN growth on silicon substrates," Rony Saha, Jonathan Anderson, Mark W. Holtz and Edwin L. Piner, J. Vac. Sci. Technol. A **41**(5), 053208 (2023). DOI: 10.1116/6.0002760
3. "Heterogeneous Integration of High-Quality Diamond on Aluminum Nitride with Low and High Seeding Density," Anupam K.C., Jonathan Anderson, Anival Ayala, Christopher Engdahl, Edwin L. Piner, and Mark W. Holtz, J. Crystal Growth **610**, (2023). DOI: 10.1016/j.jcrysgro.2023.127172
4. "Preferentially Oriented Growth of Diamond Films on Silicon with Nickel Interlayer," Anupam K.C., Anwar Siddique, Jonathan Anderson, Rony Saha, Chhabindra Gautam, Anival Ayala, Chris Engdahl, Mark W. Holtz, and Edwin L. Piner, SN Appl. Sci., **4**(226), (2022). DOI: 10.1007/s42452-022-05092-y
5. "Effect of Seeding Density on the Growth of Diamond Films by Hot-Filament Chemical Vapor Deposition from Sparse to Dense Range," Anupam K.C., Rony Saha, Jonathan Anderson, Anival Ayala, Chris Engdahl, Edwin L. Piner, and Mark Holtz, J. Appl. Phys., **130**(22), 225302 (2021). DOI: 10.1063/5.0068541
6. "Improved Electrical Properties of AlGaN/GaN High Electron Mobility Transistors by in-situ Tailoring the $SiN_x$ Passivation Layer," Anwar Siddique, Raju Ahmed, Jonathan Anderson, Mark Holtz and Edwin Piner, ACS Appl. Mater. Interfaces, **13**(15), 18264–18273 (2021). DOI: 10.1021/acsami.1c01241

7. "Integration of GaN and Diamond Using Epitaxial Lateral Overgrowth," Raju Ahmed, Anwar Siddique, Jonathan Anderson, Chhabindra Gautam, Mark Holtz and Edwin Piner, ACS Appl. Mater. Interfaces, **12**(35), 39397–39404 (2020). DOI: 10.1021/acsami.0c10065

8. "Effect of Precursor Stoichiometry on Morphology, Phase Purity and Texture Formation of Hot Filament CVD Diamond Films Grown on Si (100) Substrate," Raju Ahmed, Anwar Siddique, Rony Saha, Jonathan Anderson, Chris Engdahl, Mark Holtz and Edwin Piner, J. Mater. Sci.: Mater. Electron., **31**(11), 8597-8606 (2020). DOI: 10.1007/s10854-020-03395-7.

9. "Structure and Interface Analysis of Diamond on an AlGaN/GaN HEMT Utilizing an *In-situ* $SiN_x$ Interlayer Grown by MOCVD," Anwar Siddique, Raju Ahmed, Jonathan Anderson, Mohammad Nazari, Luke Yates, Samuel Graham, Mark Holtz, and Edwin L. Piner, ACS Appl. Electron. Mater., **1**(8), 1387-1399 (2019). DOI: 10.1021/acsaelm.9b00131

10. "Effect of Reactant Gas Stoichiometry of *in-situ* $SiN_x$ Passivation on Structural Properties of MOCVD AlGaN/GaN HEMTs," Anwar Siddique, Raju Ahmed, Jonathan Anderson, and Edwin L. Piner, J. Crystal Growth **517**, 28-34 (2019). DOI: 10.1016/j.jcrysgro.2019.03.020

11. "Selective Area Deposition of Hot Filament CVD Diamond on 100 mm MOCVD Grown AlGaN/GaN Wafers," Raju Ahmed, Anwar Siddique, Jonathan Anderson, Chris Engdahl, Mark Holtz, and Edwin L. Piner, Cryst. Growth Des. **19**(2) 672-677 (2019). DOI: 10.1021/acs.cgd.8b01260

12. "Low Thermal Boundary Resistance Interfaces for GaN-on-Diamond Devices," Luke Yates, Jonathan Anderson, Xing Gu, Cathy Lee, Tingyu Bai, Matthew Mecklenburg, Toshihiro Aoki, Mark S. Goorsky, Martin Kuball, Edwin L. Piner, and Samuel Graham, ACS Appl. Mater. Interfaces, **10**(28) 24302 (2018). DOI: 10.1021/acsami.8b07014

13. "Ultraviolet micro-Raman Stress Map of Polycrystalline Diamond Grown Selectively on Silicon Substrates Using Chemical Vapor Deposition," R. Ahmed, M. Nazari, B. L. Hancock, J. Simpson, C. Engdahl, E. L. Piner, and M. W. Holtz, Appl. Phys. Lett. **112**(18) 181907 (2018). DOI: 10.1063/1.5027507

14. "Optical Characterization and Thermal Properties of CVD Diamond Films for Integration with Power Electronics," M. Nazari, B.L. Hancock, J. Anderson, K.D. Hobart, T.I. Feygelson, M.J. Tadjer, B.B. Pate, T.J. Anderson, E.L. Piner, M.W. Holtz, Solid-State Electronics **136** 12-17 (2017). DOI: 10.1016/j.sse.2017.06.025.

15. "Hexagonal Boron Nitride Particles for Determining the Thermal Conductivity of Diamond Films Based on Near-Ultraviolet micro-Raman Mapping," B. Squires, B.L. Hancock, M. Nazari, J. Anderson, K.D. Hobart, T.I. Feygelson, M.J. Tadjer, B.B. Pate, T.J. Anderson, E.L. Piner, and M.W. Holtz, Journal of Physics D: Applied Physics, **50**(24) 24LT01 (2017). DOI: 10.1088/1361-6463/ aa6f44

16. "RF Dielectric Loss Due to MOCVD Aluminum Nitride on High Resistivity Silicon," Feyza Berber, Derek W. Johnson, Kyle M. Sundqvist, Edwin L. Piner, Gregory H. Huff, and H. Rusty Harris, Transactions on Microwave Theory and Techniques, **65**(5) (2017). DOI: 10.1109/TMTT.2017.2656865

17. "Ultraviolet and Visible micro-Raman and micro-Photoluminescence Spectroscopy Investigations of Stress on a 75-mm GaN-on-diamond Wafer," B.L. Hancock, M. Nazari, J. Anderson, E.L. Piner, F. Faili, S. Oh, D. Francis, D. Twitchen, S. Graham, and M.W. Holtz, Phys. Status Solidi C, 1600247 (2017) (IWN 2016 - Nitride Semiconductors Proceedings). DOI: 10.1002/pssc.201600247

18. “Ultraviolet Micro-Raman Spectroscopy Stress Mapping of a 75-mm GaN-on-Diamond Wafer,” B.L. Hancock, M. Nazari, J.W. Anderson, E.L. Piner, F. Faili, S. Oh, D. Twitchen, S. Graham, and M. Holtz, Appl. Phys. Lett. **108**(21) 211901 (2016). DOI: 10.1063/1.4952596

19. “Near-Ultraviolet Micro-Raman Study of Diamond Grown on GaN,” M. Nazari, B.L. Hancock, J.W. Anderson, A. Savage, E.L. Piner, S. Graham, F. Faili, S. Oh, D. Francis, D. Twitchen, and M. Holtz, Appl. Phys. Lett., **108**(3) 031901 (2016). DOI: 10.1063/1.4940200

20. "Self-heating Profile in an AlGaN/GaN Heterojunction Field-Effect Transistor Studied by Ultraviolet and Visible Micro-Raman Spectroscopy," M. Nazari, B.L. Hancock, E.L. Piner, and M.W. Holtz, IEEE Trans. Electron Devices, **62**(5), 1467-1472 (2015). DOI: 10.1109/TED.2015.2422913

21. “Challenges of Contact Module Integration for GaN-based Devices in a Si-CMOS Environment,” Derek W. Johnson, Pradhyumna Ravikirthi, Jae Woo Suh, Rinus T. P. Lee, Richard J. W. Hill, Man Hoi Wong, Edwin L. Piner and H. Rusty Harris, J. Vac. Sci. Technol. B **32**, 030606 (2014). DOI: 10.1116/1.4874801

22. “Threshold Voltage Shift Due to Charge Trapping in Dielectric-Gated AlGaN/GaN High Electron Mobility Transistors Examined in Au-Free Technology,” D.W. Johnson, R.T.P. Lee, R.J.W. Hill, M.H. Wong, G. Bersuker, E.L. Piner, P.D. Kirsch, and H.R. Harris, IEEE Trans. Electron Devices, **60**(10), 3197-3203 (2013). DOI: 10.1109/TED.2013.2282460

23. “PECVD Silicon Nitride Passivation of AlGaN/GaN Heterostructures,” I.R. Gatabi, D.W. Johnson, J.H. Woo, J.W. Anderson, M.R. Coan, E.L. Piner, and H.R. Harris, IEEE Trans. Electron Devices, **60**(3), 1082-1087 (2013). DOI: 10.1109/TED.2013.2242075

24. “InGaN/GaN Multiple-Quantum-Well Light-Emitting Diodes Grown on Si(111) Substrates with $ZrB_2$(0001) Buffer Layers,” A.H. Blake, D. Caselli, C. Durot, J. Mueller, E. Parra, J. Gilgen, A. Boley, D.J. Smith, I.S.T. Tsong, J.C. Roberts, E. Piner, K. Linthicum, J.W. Cook, Jr., D.D. Koleske, M.H. Crawford, and A.J. Fischer, J. Appl. Phys., **111**(3), 033107 (2012). DOI: 10.1063/1.368557

25. “Nanometric AlGaN/GaN HEMT Performance with Implant or Mesa Isolation,” H. Sun, A.R. Alt, S. Tirelli, D. Marti, H. Benedickter, E. Piner, and C.R. Bolognesi, IEEE Electron Device Lett., **32**(8), 1056-1058 (2011). DOI: 10.1109/LED.2011.2151172

26. “Detection of Vitellogenin, an Endocrine Disrupter Biomarker, Using AlGaN/GaN High Electron Mobility Transistors,” B.H. Chu, C.Y. Chang, K. Kroll, N. Denslow, Y-L Wang, S.J. Pearton, J. Lin, A.M. Dabiran, A.M. Wowchak, B. Cui, P.P. Chow, J.W. Johnson, P. Rajagopal, J.C. Roberts, E.L. Piner, K.J. Linthicum, and F. Ren, Phys. Stat. Sol. (C) **8**, No. 7-8, 2486–2488 (2011). DOI: 10.1002/pssc.201001171

27. “Thin-body N-face GaN Transistor Fabricated by Direct Wafer Bonding,” K.K. Ryu, J.C. Roberts, E.L. Piner, and T. Palacios, IEEE Electron Device Lett., **32**(7), 895-897 (2011). DOI: 10.1109/LED.2011.2147751

28. “Schottky-Ohmic Drain AlGaN/GaN Normally Off HEMT With Reverse Drain Blocking Capability,” C. Zhou, W. Chen, E.L. Piner, and K.J. Chen, IEEE Electron Device Lett., **31**(7), 668-670 (2010). DOI: 10.1109/LED.2010.204885

29. “Schottky-Drain Technology for AlGaN/GaN High-Electron Mobility Transistors,” B. Lu, E.L. Piner, and T. Palacios, IEEE Electron Device Lett., **31**(4), 302-304 (2010). DOI: 10.1109/LED.2010.2040704

30. "Chloride Ion Detection by InN Gated AlGaN/GaN High Electron Mobility Transistors," Byung-Hwan Chu, Hon-Way Lin, Shangjr Gwo, Yu-Lin Wang, S. J. Pearton, J.W. Johnson, P. Rajagopal, J.C. Roberts, E.L. Piner, K.J. Linthicum, and Fan Ren, J. Vacuum Science & Technology B **28**, L5 (2010). DOI: 10.1116/1.3271253

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105. "New Buffer Layers for GaN on Sapphire by Atomic Layer and Molecular Stream Epitaxy," E.L. Piner, Y.W. He, K.S. Boutros, F.G. McIntosh, J.C. Roberts, S.M. Bedair, and N.A. El-Masry, Mater. Res. Soc. Symp. Proc. **395**, 307 (1996). DOI: 10.1557/PROC-395-307

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3. Conference Proceedings

a. Refereed Conference Proceedings:

1. (Invited) "Characterizing CVD Diamond For Thermal Management of Electronics," Samuel Graham, Mark S. Goorsky, Kenneth Goodson, Mark Holtz, Edwin L. Piner, and Martin Kuball, 69th Annual Diamond Conference, July 9, 2018, University of Warwick, Warwick, UK.

2. "Chemical Vapor Deposition of Diamond on GaN Using MOCVD Grown In-Situ $SiN_x$ as Dielectric Adhesion Layer," Anwar Siddique, Raju Ahmed, Jonathan Anderson, Mohammad Nazari, Luke Yeats, Graham Samuel, Mark Holtz and Edwin L. Piner, 12th International New Diamond and Nano Carbons Conference (NDNC 2018), Materials Research Society (MRS) May 24, 2018 Flagstaff, AZ, USA.

3. "High Resolution Selective Area Deposition of Hot Filament Chemical Vapor Deposited Diamond Films on Si, GaN, and AlN," Raju Ahmed, Anwar Siddique, Jonathan Anderson, Mohammad Nazari, Mark Holtz and Edwin L. Piner, 12th International New Diamond and Nano Carbons Conference (NDNC 2018), Materials Research Society (MRS) May 24, 2018 Flagstaff, AZ, USA.

4. "Structure of Diamond-Silicon Interfaces," J. Anderson, B.L. Hancock, M. Nazari, M.S. Goorsky, M. Holtz, and E.L. Piner, J. Electron. Packag., 16th IEEE Intersociety Conf. on Thermal and Thermomechanical Phenomena in Electronic Systems (ITherm) May 30 - June 2, 2017 Orlando, FL, USA. DOI: 10.1109/ITHERM.2017.7992498

5. "Implementations of CVD Diamond on GaN device layers: Optical Characterization of Wafer-scale Stress Uniformity" Bobby Hancock, Mohammad Nazari, Jon Anderson, Edwin Piner and Mark Holtz, 16th IEEE Intersociety Conf. on Thermal and Thermomechanical Phenomena in Electronic Systems (ITherm) May 30 - June 2, 2017 Orlando, FL, USA. DOI: 10.1109/ITHERM.2017.8023954

6. (Invited) "Gallium Nitride on Silicon," Edwin L. Piner, ECS Transactions **77**(2), 95-98 (2017) Emerging Materials for Post CMOS Devices/Sensing and Applications 8, 231st ECS Meeting, New Orleans, LA, USA. DOI: 10.1149/07702.0095ecst

7. "High Voltage GaN Technology in a Silicon CMOS Environment: Challenges and Opportunities," H. Rusty Harris, Derek Johnson, Richard Hill, Edwin Piner, Man Wong, and Rinus Lee, 224th Electrochemical Society Meeting, October 30, 2013, San Francisco, CA, USA.

8. "Multi-Gate Device Architectures for GaN Based Power Switching Devices," Leo Mathew, Rajesh Rao, Edwin Piner, Jerry Fossum, and Sanjay Banerjee, 224th Electrochemical Society Meeting, October 30, 2013, San Francisco, CA, USA.

9. "Systematic Determination of Interface States and Charge Trapping Phenomenon in AlGaN/GaN MOS-HEMT Gate Stacks," Derek W. Johnson, Iman Rezanezhad-Gatabi, Jung-Hwan Woo, Kyoung-Kuen Lee, Edwin L. Piner, and H. Rusty Harris, 10th International Conference on Nitride Semiconductors (ICNS-10), August 27, 2013, Washington, D.C., USA.

10. "Self-Protected GaN Power Devices with Reverse Drain Blocking and Forward Current Limiting Capabilities," Chunhua Zhou, Wanjun Chen, Edwin L. Piner, Kevin J. Chen, Proceedings of Power Semiconductor Devices & IC's (ISPSD), 2010 22nd International Symposium on Power Semiconductor Devices & ICs, June 6-10, 2010, Hiroshima, Japan.

11. "Breakdown Mechanism in AlGaN/GaN HEMTs on Si Substrate," Bin Lu, E.L. Piner, and T. Palacios, 2010 Device Research Conference (DRC), June 21-23, 2010, South Bend, IN, USA. DOI: 10.1109/DRC.2010.5551907

12. "Coherent THz Electromagnetic Radiation Emission as a Shock Wave Diagnostic and Probe of Ultrafast Phase Transformations," E.J. Reed, M.R. Armstrong, K.Y. Kim, J.H. Glownia, M. Howard, E. Piner, and J. Roberts, Bulletin of the American Physical Society, 16th APS Topical Conference on Shock Compression of Condensed Matter, Vol. 54, Number 8, July 2, 2009, Nashville, TN, USA. DOI: 10.1063/1.3295222

13. "Coherent THz Electromagnetic Radiation Emission as a Diagnostic of Ultrafast Phase Transformations in Shocked CdSe," Evan Reed, Michael Armstrong, K.Y. Kim, James Glownia, Wiliam Howard, Edwin Piner and John Roberts, Bulletin of the American Physical Society, 16th APS Topical Conference on Shock Compression of Condensed Matter, Vol. 54, Number 8, July 2, 2009, Nashville, TN, USA.

14. "A New Mechanism for Observation of THz Acoustic Waves: Coherent THz Radiation Emission," E.J. Reed, M.R. Armstrong, K.-Y. Kim, J.M. Glownia, W.M. Howard, E.L. Piner, J.C. Roberts, Proc. SPIE **7214**, Ultrafast Phenomena in Semiconductors and Nanostructure Materials XIII, 72140P, February 6, 2009, San Jose, CA, USA. DOI: 10.1117/12.809326

15. "New Technologies for Improving the High Frequency Performance of AlGaN/GaN High Electron Mobility Transistors," J.W. Chung, E.L. Piner, J.C. Roberts, and T. Palacios, International Conf. on Advances in Electronics and Microelectronics, 2008, ENICS '08, Sept 28 – Oct 4, 2008, Valencia, Spain, EU. DOI: 10.1109/ENICS.2008.36

16. "N-face GaN/AlGaN Transistors Through Substrate Removal," J.W. Chung, E. Piner, T. Palacios, 2008 Device Research Conference (DRC), June 23-25 2008, Santa Barbara, CA, USA. DOI: 10.1109/DRC.2008.4800801

17. "A New and Better Method for Extracting the Parasitic Elements of On-Wafer GaN Transistors," A. Zarate-de Landa, J.E. Zuniga-Juarez, J.A. Reynoso-Hernandez, M.C. Maya-Sanchez, E.L. Piner, and K.J. Linthicum, IEEE/MTT-S International Microwave Symposium Digest, pp. 791-794, (2007). DOI: 10.1109/MWSYM.2007.380077

18. "High-Power and High-Voltage AlGaN/GaN HEMTs-on-Si," Chris Park, Andrew Edwards, Pradeep Rajagopal, Wayne Johnson, Sameer Singhal, Allen Hanson, Quinn Martin, Edwin L. Piner, Kevin J. Linthicum, and Isik C. Kizilyalli, 2007 IEEE Compound Semiconductor Integrated Circuit Symposium (CSIC 2007) October 14-17, 2007, Portland, OR, USA. DOI: 10.1109/CSICS07.2007.11

19. "Device Degradation Phenomena in GaN HFET Technology: Status, Mechanisms, and Opportunities," E.L. Piner, S. Singhal, P. Rajagopal, R. Therrien, J.C. Roberts, T. Li, A.W.

Hanson, J.W. Johnson, I.C. Kizilyalli, and K.J. Linthicum, International Electron Devices Meeting, (IEDM) pp. 1-4 (2006). DOI: 10.1109/IEDM.2006.346798

20. "150 W GaN-on-Si RF Power Transistor," W. Nagy, S. Singhal, R. Borges, J.W. Johnson, J.D. Brown, R. Therrien, A Chaudhari, A.W. Hanson, J. Riddle, S. Booth, P. Rajagopal, E.L. Piner, and K.J. Linthicum, 2005 IEEE MTT-S Int. Microwave Symp. Digest, June 2005.
21. "AlGaN/GaN Heterostructure Field Effect Transistors Fabricated on 100mm Si/poly SiC Composite Substrates," J.C. Roberts, P. Rajagopal, J.W. Cook, R.J. Therrien, E.L. Piner, K.J. Linthicum, K.D. Hobart, M. Twigg, J. Mittereder, S. Binari, and F.J. Kub, Proceedings – Electrochemical Society 8th International Symp. on Semi. Wafer Bonding, pp. 151-156 (2005).
22. "25W X-band GaN on Si MMIC," D.M. Fanning, L.C. Witkowski, C. Lee, D.C. Dumka, H.Q. Tseng, P. Saunier, W. Gajewski, E.L. Piner, K.J. Linthicum, and J.W. Johnson, 2005 International Conf. on Compound Semi. Manufacturing Technologies (GaAs MANTECH) Digest, 2005.
23. "Material, Process, and Device Development of GaN-Based HFETs on Silicon Substrates," J.W. Johnson, J. Gao, K. Lucht, J. Williamson, C. Strautin, J. Riddle, R. Therrien, P. Rajagopal, J.C. Roberts, A. Vescan, J.D. Brown, A. Hanson, S. Singhal, R. Borges, E.L. Piner, and K.J. Linthicum, Proceedings – Electrochemical Society, Honolulu, HI, USA, vol. 6, pp. 405-419 (2004).
24. "Development of a GaN Transistor Process for Linear Power Applications," A.W. Hanson, R. Borges, J.D. Brown, J.W. Cook, Jr., T. Gehrke, J.W. Johnson, K. Linthicum, S. Peters, E. Piner, P. Rajagopal, J.C. Roberts, S. Singhal, R. Therrien, and A. Vescan, GaAs MANTECH (2004).
25. "Temperature Characterization of NDR in AlGaN/GaN HFETs," H. Maher, C.R. Bolognesi, E.L. Piner, Proceeding of the 31st European Solid-State Device Research Conference, pp. 327-330, September 11-13, 2001. DOI: 10.1109/ESSDERC.2001.195267
26. "Optical and Structural Studies of Compositional Inhomogeneity in Strain-Relaxed Indium Gallium Nitride Films," L.H. Robins, J.T. Armstrong, R.B. Marinenko, M.D. Vaudin, C.E. Bouldin, J.C. Woicik, A.J. Paul, W.R. Thurber, K.E. Miyano, C.A. Parker, J.C. Roberts, S.M. Bedair, E.L. Piner, M.J. Reed, N.A. El-Masry, S.M. Donovan, and S.J. Pearton, Proceedings of the IEEE 27th International Symp. On Compound Semi., pp. 507-512 (2000). DOI: 10.1109/ISCS.2000.947207

6. Book Reviews:

1. Materials Research Society, Spring 2012 Symposium G; Reliability and Materials Issues of III-V and II-VI Semiconductor Optical and Electron Devices and Materials II, Osamu Ueda, Mitsuo Fukuda, Kenji Shiojima, and Edwin Piner, April 9 – 13, 2012, San Francisco, CA, USA [co-sponsored by Japan Society of Applied Physics (JSAP)].
2. Materials Research Society, Fall 2009 Symposium B; Reliability and Materials Issues of Semiconductor Optical and Electrical Devices & Materials, Osamu Ueda, Mitsuo Fukuda, Steve Pearton, Edwin Piner, and Paolo Montangero, November 30 – December 4, 2009, Boston, MA, USA.
3. Materials Research Society, Spring 2008 Symposium C; Advances in GaN, GaAs, SiC and Related Alloys on Silicon Substrates, T. Li, J.M. Redwing, M. Mastro, E.L. Piner, and A. Dadgar, March 24-28, 2008, San Francisco, CA, USA. (Including symposium proceedings editing and publishing.)

7. Other Works in Print:

US Patents (equivalent international patents, not listed):

10,903,076 – "Material selective regrowth structure and method," Edwin L. Piner, January 26, 2021.

10,504,725 – "Material selective regrowth structure and method," Edwin L. Piner, December 10, 2019.

10,177,229 – "Semiconductor material having a compositionally-graded transition layer," T.W. Weeks, Jr., E.L. Piner, T. Gehrke, and K.J. Linthicum, January 8, 2019.

10,096,701 – "Gallium nitride materials and methods associated with the same" E.L. Piner, J.C. Roberts and P. Rajagopal, October 9, 2018.

9,461,119 – "Semiconductor structure with compositionally-graded transition layer," T.W. Weeks, Jr., E.L. Piner, T. Gehrke, and K.J. Linthicum, October 4, 2016.

9,437,687 – "III-nitride based semiconductor structure," T.W. Weeks, Jr., E.L. Piner, T. Gehrke, and K.J. Linthicum, September 6, 2016.

9,437,686 – "Gallium nitride devices with discontinuously graded transition layer," T.W. Weeks, Jr., E.L. Piner, T. Gehrke, and K.J. Linthicum, September 6, 2016.

9,064,775 – "Gallium nitride semiconductor structures with compositionally-graded transition layer," T.W. Weeks, Jr., E.L. Piner, T. Gehrke, and K.J. Linthicum, June 23, 2015.

8,937,335 – "Gallium nitride devices with aluminum nitride intermediate layer," T.W. Weeks, Jr., E.L. Piner, T. Gehrke, and K.J. Linthicum, January 20, 2015.

8,928,035 – "Gallium nitride devices with gallium nitride alloy intermediate layer," T.W. Weeks, Jr., E.L. Piner, T. Gehrke, and K.J. Linthicum, January 6, 2015.

8,928,034 – "Gallium nitride devices with aluminum nitride alloy intermediate layer," T.W. Weeks, Jr., E.L. Piner, T. Gehrke, and K.J. Linthicum, January 6, 2015.

8,748,298 – "Gallium nitride materials and methods associated with the same" E.L. Piner, J.C. Roberts and P. Rajagopal, June 10, 2014.

8,592,862 – "Gallium nitride semiconductor structures with compositionally-graded transition layer," T.W. Weeks, Jr., E.L. Piner, T. Gehrke, and K.J. Linthicum, November 26, 2013.

8,368,117 – "III-nitride materials including low dislocation densities and methods associated with the same," E.L. Piner, J.C. Roberts, and P. Rajagopal, February 5, 2013.

8,344,417 – "Gallium nitride semiconductor structures with compositionally-graded transition layer" T.W. Weeks, Jr., E.L. Piner, T. Gehrke, and K.J. Linthicum, January 1, 2013.

8,343,824 – "Gallium nitride material processing and related device structures" E.L. Piner, J.W. Johnson, and J.C. Roberts, January 1, 2013.

8,105,921 – "Gallium nitride materials and methods" T.W. Weeks, Jr., E.L. Piner, T. Gehrke, and K.J. Linthicum, January 31, 2012.

8,026,581 – "Gallium nitride material devices including diamond regions and methods associated with the same," A.W. Hanson and E.L. Piner, September 27, 2011.

7,994,540 – "Gallium nitride material transistors and methods associated with the same," W.H. Nagy, R.M. Borges, J.D. Brown, A.D. Chaudhari, J.W. Cook, Jr., A.W. Hanson, J.W. Johnson, K.J. Linthicum, E.L. Piner, P. Rajagopal, J.C. Roberts, S. Singhal, R.J. Therrien, and A. Vescan, August 9, 2011.

7,791,106 – "Gallium nitride material structures including substrates and methods associated with the same," E.L. Piner, P. Rajagopal, J.C. Roberts, and K.J. Linthicum, September 7, 2010.

7,687,827 – "III-nitride materials including low dislocation densities and methods associated with the same," E.L. Piner, J.C. Roberts, and P. Rajagopal, March 30, 2010.

7,569,871 – "Gallium nitride material transistors and methods associated with the same," W.H. Nagy, J.W. Johnson, E.L. Piner, P. Rajagopal, J.C. Roberts, S. Singhal, R.T. Therrien, A. Vescan, R.M. Borges, J.D. Brown, A.D. Chaudhari, J.W. Cook, Jr., A.W. Hanson, and K.J. Linthicum, August 4, 2009.

7,365,374 – "Gallium nitride material structures including substrates and methods associated with the same," E.L. Piner, P. Rajagopal, J.C. Roberts, and K.J. Linthicum, April 29, 2008.

7,361,946 – "Semiconductor device-based sensors," J.W. Johnson, E.L. Piner and K.J. Linthicum, April 22, 2008.

7,352,016 – "Gallium nitride material transistors and methods associated with the same," W.H. Nagy, R.M. Borges, J.D. Brown, A.D. Chaudhari, J.W. Cook, Jr., A.W. Hanson, J.W. Johnson, K.J. Linthicum, E.L. Piner, P. Rajagopal, J.C. Roberts, S. Singhal, R.J. Therrien, and A. Vescan, April 1, 2008.

7,352,015 – "Gallium nitride materials and methods associated with the same" E.L. Piner, J.C. Roberts and P. Rajagopal, April 1, 2008.

7,339,205 – "Gallium nitride materials and methods associated with the same," E.L. Piner, J.C. Roberts and P. Rajagopal, March 4, 2008.

7,247,889 – "III-nitride material structures including silicon substrates," A.W. Hanson, J.C. Roberts, E.L. Piner, and P. Rajagopal, July 24, 2007.

7,135,720 – "Gallium nitride material transistors and methods associated with the same," W.H. Nagy, R.M. Borges, J.D. Brown, A.D. Chaudhari, J.W. Cook, Jr., A.W. Hanson, J.W. Johnson, K.J. Linthicum, E.L. Piner, P. Rajagopal, J.C. Roberts, S. Singhal, R.J. Therrien, and A. Vescan, November 14, 2006.

6,727,531 / RE44,538 – "Indium gallium nitride channel high electron mobility transistors, and methods of making the same," J.M. Redwing and E.L. Piner, April 27, 2004.

6,649,287 – "Gallium nitride materials and methods" T.W. Weeks, Jr., E.L. Piner, T. Gehrke, and K.J. Linthicum, November 18, 2003.

6,617,060 – "Gallium nitride materials and methods" T.W. Weeks, Jr., E.L. Piner, T. Gehrke, and K.J. Linthicum, September 9, 2003

6,611,002 – "Gallium nitride material devices and methods including backside vias" T.W. Weeks, Jr., E.L. Piner, R.M Borges, and K.J. Linthicum, August 26, 2003.

B. Works not in Print

1. Papers Presented at Professional Meetings:

1. "HAADF-STEM Study of Filament Material in Hot Filament CVD Diamond Films," Jonathan Anderson, Raju Ahmed, Anwar Siddique, and Edwin L. Piner, Microscopy & Microanalysis 2019 Meeting (M&M 2019), August 4-8, 2019, Portland, OR USA.
2. "Compositional Changes Occurring in GaN-on-Diamond Adhesion Layers," Jonathan Anderson and Edwin L. Piner, 13th International Conference on Nitride Semiconductors 2019 (ICNS-13), July 7-12, 2019, Bellevue, WA, USA.
3. "AlGaN/GaN HEMT 2DEG Impact by *in-situ* $SiN_x$ Passivating Layer Stoichiometry Grown by MOCVD," Anwar Siddique, Raju Ahmed, Jonathan Anderson and Edwin L. Piner, 13th International Conference on Nitride Semiconductors 2019 (ICNS-13), July 7-12, 2019, Bellevue, WA, USA.
4. "Characterizing CVD Diamond for Thermal Management of Electronics," Samuel Graham, Mark Goorsky, Kenneth Goodson, Mark Holtz, Edwin L. Piner, and Martin Kuball, Diamond Conference 2018, July 12, 2018, Warwick, UK.
5. "Chemical Vapor Deposition of Diamond on GaN Using MOCVD Grown In Situ $SiN_x$ as Dielectric Adhesion Layer," Anwar Siddique, Raju Ahmed, Jonathan Anderson, Mohammad Nazari, Mark Holtz and Edwin Piner, 12th International New Diamond and Nano Carbons Conference (NDNC 2018), May 24, 2018, Flagstaff, AZ, USA.
6. "High Resolution Selective Area Deposition of Hot Filament Chemical Vapor Deposited Diamond Films on Si, AlN, and GaN," Raju Ahmed, Anwar Siddique, Jonathan Anderson, Mohammad Nazari, Mark Holtz and Edwin Piner, 12th International New Diamond and Nano Carbons Conference (NDNC 2018), May 24, 2018, Flagstaff, AZ, USA.
7. "Structure of Diamond-Silicon Interfaces," Jonathan Anderson, Logan Hancock, Mohammad Nazari, Mark Goorsky, Mark W. Holtz, and Edwin L. Piner, Sixteenth Intersociety Conference on Thermal and Thermomechanical Phenomena in Electronic Systems (ITherm), May 30, 2017, Lake Buena Vista, FL USA.
8. "Microstructure and Thermal Properties of CVD Diamond for Integration with GaN," Mark W. Holtz, B. Logan Hancock, Jonathan Anderson, Mohammad Nazari, Brian Squires, and Edwin L. Piner, International Semiconductor Device Research Symposium ISDRS 2016, December 7-9, 2016, Bethesda, MD, USA.
9. "UV Micro-Raman and Photoluminescence Stress-Mapping on a GaN HEMT-on-Diamond Wafer," B. Logan Hancock, Mohammad Nazari, Jonathan Anderson, Edwin Piner, and Mark Holtz, MRS Intl. Workshop on Nitride (IWN) Semiconductors, October 2016, Orlando, FL, USA.
10. "Morphology Study of Diamond Grown on GaN Using Near-Ultraviolet micro-Raman Technique," Mohammad Nazari, B. Logan Hancock, Jonathan Anderson, Alissa Savage, Edwin L. Piner, and Mark W. Holtz, MRS Intl. Workshop on Nitride (IWN) Semiconductors, October 2016, Orlando, FL, USA.
11. "Investigation of Stresses in GaN HEMT Layers on a Diamond Substrate using Micro-Raman Spectroscopy," B. Logan Hancock, M. Nazari, J. Anderson, E. Piner, M. Holtz, 2016 Compound Semiconductor Integrated Circuit Symposium (CSICS), October 23, 2016, Austin, TX, USA.
12. "Wafer Stress Mapping of GaN-on-Diamond by Micro-Raman Spectroscopy," B. Logan Hancock, Mohammad Nazari, Jonathan Anderson, Edwin L. Piner, and Mark W. Holtz,

40th Workshop on Compound Semiconductor Devices and Integrated Circuits – Europe (WOCSDICE), June 6, 2016, Aveiro, Portugal, EU.

13. "Implementations of CVD Diamond on GaN Device Layers: Optical Characterization of Wafer-scale Stress Uniformity," B.L. Hancock, M. Nazari, J. Anderson, E.L. Piner, and M.W. Holtz, Sixteenth Intersociety Conference on Thermal and Thermomechanical Phenomena in Electronic Systems (ITherm) IEEE, May 30, 2016, Orlando, FL, USA.
14. "DARPA Round Robin: Thermal Properties of Diamond," M. Holtz, E. L. Piner, S. Graham, M. Kuball, M. Goorsky, M. Asheghi, K. Goodson, Texas State University, Georgia Tech, Univ. Bristol, UCLA, Stanford Univ., Defense Innovation, Technology Acceleration Challenges, December 1, 2015, Austin, TX, USA.
15. "AlGaN/GaN Heterojunction Field Effect Transistor Self-heating Investigation by UV and Visible Micro-Raman Spectroscopy," M. Nazari, B.L. Hancock, E.L. Piner, and M.W. Holtz, 2015 Workshop on Compound Semiconductor Devices and Integrated Circuits – Europe (WOCSDICE), June 9, 2015, Smolenice Castle, Slovakia, EU.
16. "Self-heating in an AlGaN/GaN transistor studied by ultraviolet and visible micro-Raman scattering," M. Nazari, B.L. Hancock, E.L. Piner, and M.W. Holtz, Bulletin of the American Physical Society, APS March Meeting 2015, Volume 60, Number 1, March 4, 2015, San Antonio, TX, USA.
17. "Investigation of AlGaInN Microstructure," J.W. Anderson (ST), N. Simpson (ST), F. Ruiz, A. Ponce, O. Laboutin, Y. Cao, J.W. Johnson, and E.L. Piner, 32nd International Conference on the Physics of Semiconductors, August 14, 2014, Austin, TX, USA.
18. "Self-Heating in a Two-Dimensional Electron Gas at the Interface Between GaN & AlGaN Studied by Ultraviolet & Visible Micro-Raman Scattering," M. Nazari, B.L. Hancock, E.L. Piner, J. Berg, and M.W. Holtz, 32nd International Conference on the Physics of Semiconductors, August 14, 2014, Austin, TX, USA.
19. "Junction Temperature & Electroluminescence Measurements in High Brightness Ultraviolet Light-Emitting Diodes," B.L. Hancock, E.L. Piner, J. Berg, and M.W. Holtz, 32nd International Conference on the Physics of Semiconductors, August 14, 2014, Austin, TX, USA.
20. "GaN High Electron Mobility Transistors," Jonathan W. Anderson (ST), Kyoung-Keun Lee, and Edwin L. Piner, Texas Section Joint APS/AAPT/SPS Spring 2012 Meeting, Session E2, Angelo State University, May 23, 2012, San Angelo, TX, USA.
21. "N-polar AlGaN/GaN/AlGaN DH-HEMT on Diamond Produced By Epi-Inverted Wafer Processing," E.L. Piner and J.C. Roberts, 9th International Conference on Nitride Semiconductors (ICNS-9), July 10-15, 2011, Glasgow, Scotland.
22. "GaN/Diamond AlGaN/GaN/AlGaN DH-HEMT Produced By Epi-Inverted Wafer Processing," E.L. Piner and J.C. Roberts, Electronic Materials Conference 2011, June 22-24, 2011, University of California, Santa Barbara, CA, USA.
23. "Top-Down Fabrication of N-face GaN/AlGaN Nanowire Transistors," M. Azize, K. Ryu, E. Piner and T. Palacios, 38th International Symposium on Compound Semiconductors (ISCS 2011), May 22-26, 2011, Berlin, Germany.
24. "A Comparison of Mesa and Ion Implantation Isolation in AlGaN/GaN HEMTs," H.F. Sun, D. Marti, S. Tirelli, A.R. Alt, E.L. Piner and C.R. Bolognesi, 38th International

Symposium on Compound Semiconductors (ISCS 2011), May 22-26, 2011, Berlin, Germany.

25. "GaN/Diamond AlGaN/GaN/AlGaN HEMT – The Next Frontier," E.L. Piner and J.C. Roberts, IEEE Microwave Theory and Techniques Society International Microwave Symposium, High-Power-Density Packaging of Gallium Nitride Workshop (IEEE MTT-S 2010 Workshop WME IMS), May 23, 2010, Anaheim, CA, USA.
26. "Power Scaling of GaN/Diamond Double Heterostructure HEMT," E.L. Piner and J.C. Roberts, Government Microcircuit Applications & Critical Technology Conference (GOMACTech10), March 24, 2010, Reno, NV, USA.
27. "Giant Excitonic Transport in GaN/AlGaN Surface Quantum Wells," Y.D. Glinka, S.V. Goupalov, T.V. Shahbazyan, H.O. Everitt, J. Roberts, P. Rajagopal, J. Cook, E. Piner, K. Linthicum, APS March Meeting 2010, Volume 55, Number 2, March 15, 2010, Portland, Oregon, USA.
28. "Atomic transformation pathways from THz radiation generated by shock-induced phase transformations," Evan Reed, Michael Armstrong, Ki-Yong Kim, James Glownia, Mike Howard, Edwin Piner, John Roberts APS March Meeting 2010, Volume 55, Number 2, March 18, 2010, Portland, Oregon, USA.
29. "Thermal Management in GaN HEMTs via Heterogeneous Integration Using Micro-transfer Printing with Advanced Thin Film Diamond Thermal Materials," J. Carlisle, H. Zeng, H. Kim, J.A. Rogers, E. Menard, S. Dooley, J. Jur, M. Johnson, and E. Piner, Materials Research Society Symposium; Diamond Electronics and Bioelectronics – Fundamentals to Applications III, November 30, 2009, Boston, MA, USA.
30. "Chloride Ion Detection with InN Gated AlGaN/GaN High Electron Mobility Transistor," B.H. Chu, H-W. Lin, S. Gwo, Y-L. Wang, S.J. Pearton, J.W. Johnson, P. Rajagopal, J.C. Roberts, E.L. Piner, K.J. Linthicum and F. Ren, Materials Research Society Symposium; III-Nitride Materials for Sensing, Energy Conversion, and Controlled Light-Matter Interactions, December 2, 2009, Boston, MA, USA.
31. "Fast Detection of Perkinsus Marinus, a Prevalent Pathogen of Oysters and Clams from Sea Water," Y.-L. Wang, B.H. Chu, K-H. Chen, C. Chang, T. Lele, G. Papdi, J. Coleman, B Sheppard, C. Dungan, S. Pearton, W. Johnson, K. Linthicum, P. Rajagopal, J. Roberts, E. Piner and F. Ren, Materials Research Society Symposium; III-Nitride Materials for Sensing, Energy Conversion, and Controlled Light-Matter Interactions, December 2, 2009, Boston, MA, USA.
32. "Epi-Inverted Nitrogen-Polar GaN/Diamond AlGaN/GaN/AlGaN HEMT," E.L. Piner and J.C. Roberts, 8th International Conference on Nitride Semiconductors (ICNS-8), October 18-23, 2009, Jeju, South Korea.
33. "Seamless On-wafer Integration of GaN HEMTs and Si(100) MOSFETs," J.W. Chung, E.L. Piner, and T. Palacios, 67th Device Research Conference, June 22-24, 2009, Penn State University, University Park, PA, USA.
34. "Enhancement-Mode AlGaN/GaN HEMTs with High Linearity Fabricated by Hydrogen Plasma Treatment," B. Lu, O.I. Saadat, E.L. Piner, and T. Palacios, 67th Device Research Conference, June 22-24, 2009, Penn State University, University Park, PA, USA.
35. "Epi-Inverted N-Face GaN/Diamond for AlGaN/GaN/AlGaN FETs," E.L. Piner, J.W. Zimmer, J.C. Roberts, G. Chandler, and R.A. Sadler, 2009 Workshop on Compound

Semiconductor Devices and Integrated Circuits – Europe (WOCSDICE), May 18-20, 2009, Malaga, Spain, EU.

36. "c-erbB-2 sensing using AlGaN/GaN High Electron Mobility Transistors for Breast Cancer Detection," K. Chen, B. Kang, H. Wang, T. Lele, Y. Wang, C. Chang, S. Pearton, W. Johnson, P. Rajagopal, J. Roberts, E. Piner, K. Linthicum and F. Ren, 215th Electrochemical Society Meeting, May 25, 2009, San Francisco, CA, USA.

37. "Novel AlGaN/GaN Nitrogen-Face HEMT Structure for Thermally Enhanced Power Amplifiers," E.L. Piner, J.C. Roberts, R.A. Sadler, and J. Gao, Government Microcircuit Applications & Critical Technology Conference (GOMACTech09), March 18, 2009, Orlando, FL, USA.

38. "Gallium Nitride Light-Emitting Diodes Grown on Silicon Substrates," E. Parra, J. Gilgen, A. Blake, D. Caselli, C. Durot, J. Mueller, Ig Tsong, J. Roberts, E. Piner, K. Linthicum, J. Cook, Jr., D. Koleske, and M. Crawford, Bulletin of the American Physical Society, 2008 Joint Fall Meeting of the Texas and Four Corners Sections of APS, AAPT, and Zones 13 and 16 of SPS, and the Societies of Hispanic & Black Physicists, Vol. **53**, Number 11, October 17, 2008; El Paso, TX, USA.

39. "Influence of Passivation on the Transport Study of AlGaN/GaN: A Focus on High T Hall Effect Characterization," J. Daniel, S. Elhamri, R. Berney, M. Ahoujja, W. Mitchel, J. Roberts, P. Rajagopal, J. Cook, E. Piner, and K. Linthicum, Bulletin of the American Physical Society, 2008 Spring Meeting of the Ohio-Region Section of APS, Vol. **53**, Number 3, March 28, 2008, Youngstown, OH, USA.

40. "AlGaN Transition Layers on Si(111) Substrates – Observations of Microstructure and Impact on Material Quality," J.C. Roberts, J.W. Cook, Jr., P. Rajagopal, E.L. Piner, and K.J. Linthicum, Materials Research Society Symposium; Advances in GaN, GaAs, SiC and Related Alloys on Silicon Substrates, March 24-28, 2008, San Francisco, CA, USA.

41. "New Technologies for Improving the High Frequency Performance of AlGaN/GaN High Electron Mobility Transistors," J.W. Chung, E.L. Piner, J.C. Roberts, and T. Palacios, 2008 International Conf. on Advances in Electronics and Microelectronics, ENICS '08, September 28 – October 4, 2008, Valencia, Spain, EU.

42. "Gallium Nitride HEMT Development for Decade-Wide Amplifier Applications," A. Balistreri, J. Jimenez, M.-Y. Kao, C. Lee, P. Saunier, P. Chao, K. Chu, A. Immorlica, A. Souzis, I. Eliashevich, S. Guo, J. Ditri, P. Bronecke, E. Piner, J. del Alamo, J. Joh, and M. Shur, Government Microcircuit Applications & Critical Technology Conference (GOMACTech08), March 17-19, 2008, Las Vegas, NV, USA.

43. "Application of Highly Reliable Wide Bandgap GaN on Silicon MMIC to Weapon Data Linkes," D. Punatar, D. Landt, and E.L. Piner, Defense Manufacturing Conference (DMC 2007), December 3-6, 2007, Las Vegas, NV, USA.

44. "A Method to Optimize Transport Properties of AlGaN/GaN on Silicon," J.D. Daniel, S. Elhamri, R. Berney, M. Ahoujja, W.C. Mitchel, J.C. Roberts, P. Rajagopal, J.W. Cook, Jr., E.L. Piner, and K.J. Linthicum, Bulletin of the American Physical Society, 2007 Ohio Section APS/SOS/AAPT Joint Fall Meeting, Vol. **52**, Number 15, October 19, 2007, Oxford, OH, USA.

45. "A New and Better Method for Extracting the Parasitic Elements of On-Wafer GaN Transistors," A. Zarate-de Landa, J.E. Zuniga-Juarez, J.A. Reynoso-Hernandez, M.C.

Maya-Sanchez, E.L. Piner, and K.J. Linthicum, 2007 IEEE/MTT-S International Microwave Symposium, June 3-8, 2007, Honolulu, HI, USA.

46. "Gallium Nitride for Wide-Band Applications," A. Balistreri, J. Jimenez, M.Y. Kao, C. Lee, P. Saunier, P.C. Chao, K. Chu, A. Immorlica, A. Souzis, I. Eliashevich, S. Guo, P. Bronecke, E. Piner, J. del Alamo, J. Joh, and M. Shur, Government Microcircuit Applications & Critical Technology Conference (GOMACTech07), March 19-22, 2007, Lake Buena Vista, FL, USA.

47. "Characterization of GaN/Si Using Capacitance Spectroscopies," S.R. Smith, J.C. Roberts, P. Rajagopal, J.W. Cook E.L. Piner, K.J. Linthicum, and S. Elhamri, Materials Research Society Symposium; Advances in III-V Nitride Semiconductor Materials and Devices, November 27 – December 1, 2006, Boston, MA, USA.

48. "GaN-on-Si Reliability: A Comparative Study Between Process Platforms," S. Singhal, A. Chaudhari, A.W. Hanson, J.W. Johnson, R. Therrien, P. Rajagopal, T. Li, C. Park, A.P. Edwards, E.L. Piner, I.C. Kizilyalli, and K.J. Linthicum, Microelectronics Reliability: 2006 Reliability of Compound Semiconductor (ROCS) Workshop, October 30, 2006, San Antonio, TX, USA.

49. "Affordable High Power AlGaN/GaN HEMTs on 4-inch 3C poly-SiC Substrates," G. Augustine, J.D. Hartman, E.C. Elvey, E.L. Piner, J.C. Roberts, K.J. Linthicum, H.G. Henry, R.C. Brooks, and R.C. Clarke, Government Microcircuit Applications & Critical Technology Conference (GOMACTech06), March 20-23, 2006, San Diego, CA, USA.

50. "Nonequilibrium Carrier Dynamics in AlGaN/GaN Surface Quantum Wells Monitored by Time-Resolved Photoluminescence Spectroscopy," Y. D. Glinka, J. V. Foreman, W. Davenport, H. O. Everitt, X. Zhang, I. P. Wellnius, J. F. Muth, J. Roberts, P. Rajagopal, J. Cook, E. Piner, and K. Linthicum, Bulletin of the American Physical Society, 2006 APS March Meeting, March 13, 2006, Baltimore, MD, USA.

51. "Reliability of Large Periphery GaN-on-Silicon HFETs," S. Singhal, T. Li, A. Chaudhari, A.W. Hanson, R. Therrien, J.W. Johnson, W. Nagy, J. Marguart, P. Rajagopal, J.C. Roberts, E.L. Piner, I.C. Kizilyalli, and K.J. Linthicum, Microelectronics Reliability: 2005 Reliability of Compound Semiconductor (ROCS) Workshop, October 30, 2005, Palm Springs, CA, USA.

52. "AlGaN/GaN HEMTs on Silicon: Reliability, Performance, and Affordability," Edwin L. Piner, 2005 Radio Frequency Module Manufacturing Workshop, August 23-24, 2005, Redstone Arsenal, Huntsville, AL, USA.

53. "150 W GaN-on-Si RF Power Transistor," W. Nagy, S. Singhal, R. Borges, J.W. Johnson, J.D. Brown, R. Therrien, A Chaudhari, A.W. Hanson, J. Riddle, S. Booth, P. Rajagopal, E.L. Piner, and K.J. Linthicum, 2005 IEEE MTT-S International Microwave Symposium, June 12-17, 2005, Long Beach, CA, USA.

54. "AlGaN/GaN Heterostructure Field Effect Transistors Fabricated on 100mm Si/poly SiC Composite Substrates," J.C. Roberts, P. Rajagopal, J.W. Cook, R.J. Therrien, E.L. Piner, K.J. Linthicum, K.D. Hobart, M. Twigg, J. Mittereder, S. Binari, and F.J. Kub, Electrochemical Society 8th International Symposium on Semiconductor Wafer Bonding, May 15-20, 2005, Quebec, Canada.

55. "25W X-band GaN on Si MMIC," D.M. Fanning, L.C. Witkowski, C. Lee, D.C. Dumka, H.Q. Tseng, P. Saunier, W. Gajewski, E.L. Piner, K.J. Linthicum, and J.W. Johnson,

2005 International Conference on Compound Semiconductor Manufacturing Technology (CS MANTECH), April 11-14, 2005, New Orleans, LA, USA.

56. "Development of a GaN Transistor Process for Linear Power Applications," A.W. Hanson, R. Borges, J.D. Brown, J.W. Cook, Jr., T. Gehrke, J.W. Johnson, K. Linthicum, S. Peters, E. Piner, P. Rajagopal, J.C. Roberts, S. Singhal, R. Therrien, and A. Vescan, 2004 International Conference on Compound Semiconductor Manufacturing Technology (GaAs MANTECH), May 2004, Miami, FL, USA.

57. "Material, Process, and Device Development of GaN-Based HFETs on Silicon Substrates," J.W. Johnson, J. Gao, K. Lucht, J. Williamson, C. Strautin, J. Riddle, R. Therrien, P. Rajagopal, J.C. Roberts, A. Vescan, J.D. Brown, A. Hanson, S. Singhal, R. Borges, E.L. Piner, and K.J. Linthicum, Electrochemical Society Meeting, October 5, 2004, Honolulu, HI, USA.

58. "MOCVD AlGaN/GaN HFETs on Si: Challenges and Issues," P. Rajagopal, J.C. Roberts, J.W. Cook, Jr., J. Brown, E. Piner, and K. Linthicum, Materials Research Society Symposium; GaN and Related Alloys – 2003, December 1-5, 2003, Boston, MA, USA.

59. "Stress and Strain Management of III-Nitride Epitaxy on (111) Silicon," E.L. Piner, P. Rajagopal, J.C. Roberts, T. Gehrke, T.W. Weeks, Jr., and K.J. Linthicum, 2003 Lawrence Symposium on Critical Issues in Epitaxy, October 9-11, 2003, Tempe, AZ, USA.

60. "Large-Area, Device Quality GaN on Si Using a Novel Transition Layer Scheme," P. Rajagopal, T. Gehrke, J.C. Roberts, J.D. Brown, T.W. Weeks, E.L. Piner, and K.J. Linthicum, Materials Research Society Symposium; GaN and Related Alloys – 2002, December 2-6, 2002, Boston, MA, USA.

61. "Gallium Nitride on Silicon," R. Borges, E. Piner, A. Vescan, J.D. Brown, S. Singhal, and R. Therrien, 2001 International Semiconductor Device Research Symposium (ISDRS), December 5-7, 2001, Washington, DC, USA.

62. "Optical and Structural Studies of Compositional Inhomogeneity in Strain-Relaxed Indium Gallium Nitride Films," L.H. Robins, J.T. Armstrong, R.B. Marinenko, M.D. Vaudin, C.E. Bouldin, J.C. Woicik, A.J. Paul, W.R. Thurber, K.E. Miyano, C.A. Parker, J.C. Roberts, S.M. Bedair, E.L. Piner, M.J. Reed, N.A. El-Masry, S.M. Donovan, and S.J. Pearton, 2000 IEEE International Symposium On Compound Semiconductors, October 2-5, 2000, Monterey, CA, USA.

63. "A Study of On-State and Off-State Breakdown Voltages in GaN MESFETs," A. Kuliev, C. Lee, W. Lu, E. Piner, S.R. Bahl, and I. Adesida, 2000 IEEE/Cornell Conference on High Performance Devices, August 7-9, 2000, Ithaca, NY, USA.

64. "Recessed Gate GaN MESFET Using ICP-RIE for High Temperature Microwave Applications," C. Lee, W. Lu, E. Piner, and I. Adesida, 58$^{th}$ Device Research Conference, June 19-21, 2000, Denver, CO, USA.

65. "Phase Separation and Ordering in InGaN Grown by MOCVD," N.A. El-Masry, E.L. Piner, S.X. Liu, and S.M. Bedair, 10th International Conf on Semiconducting and Insulating Materials (IEEE, SIMC-X) June 1998, Berkeley, CA, USA.

66. "Detection and Analysis of Phase Separation in Metalorganic Chemical Vapor Deposition InGaN," E.L. Piner, N.A. El-Masry, S.X. Liu, and S.M. Bedair, Materials Research Society Symposium; Nitride Semiconductors, December 1-5, 1997, Boston, MA, USA.

67. "New Buffer Layers for GaN on Sapphire by Atomic Layer and Molecular Stream Epitaxy," E.L. Piner, Y.W. He, K.S. Boutros, F.G. McIntosh, J.C. Roberts, S.M. Bedair, and N.A. El-Masry, Materials Research Society Symposium; Gallium Nitride and Related Materials, November 27 - December 1, 1995, Boston, MA, USA.

2. Invited Talks, Lectures, and Presentations:
    1. *INVITED* "III-Nitrides and Diamond Integration," Edwin L. Piner, UT-Dallas MSE Colloquium Series, September 9, 2022, Dallas, TX, USA.
    2. *INVITED* "III-Nitrides and Diamond Integration, Challenges and Opportunities," Edwin L. Piner, Summer School of Information Engineering (SSIE) – "Silvano Pupolin", IEEE Italy Section PhD Summer School, July 13, 2022, Bressanone, Italy, EU.
    3. *SEMINAR* "GaN / Diamond: Combination Challenges and Heterointerface Optimization," Edwin L. Piner, Trinity University, February 25, 2020, San Antonio, TX, USA.
    4. *SEMINAR* "Heterointerface Science of Gallium Nitride / Diamond," Edwin L. Piner, Lamar University, April 5, 2019, Beaumont, TX, USA.
    5. *INVITED* "Gallium Nitride on Silicon," Edwin L. Piner, 231st Electrochemical Society Meeting, Emerging Materials for Post CMOS Devices/Sensing and Applications 8 Symposium, May 30, 2017, New Orleans, LA, USA.
    6. *SEMINAR* "GaN-on-Silicon for RF PAs: The brief history and lessons going forward," Edwin L. Piner, Infineon Technologies AG, May 12, 2015, Villach, Austria.
    7. *SEMINAR SERIES* Edwin L. Piner, Infineon Technologies AG, May 21 & 22, 2014, Villach, Austria.
        a. "Nucleation of III-Nitrides on Silicon – Key challenges for initiating III-nitride epitaxy on silicon"
        b. "Crystal Defects and Device Functionality Impacts"
        c. "AlGaN/GaN HEMT Optimization"
        d. "Epitaxial Influences on Reliability"
    8. *SEMINAR* "GaN on Si: Material Challenges and Opportunities" Edwin L. Piner, SunEdison, May 1, 2014, St. Louis, MO, USA
    9. *SEMINAR* "GaN / Diamond: Optimizing the Combination to Take Advantage of Material Properties," Edwin L. Piner, Trinity University, September 18, 2012, San Antonio, TX, USA.
    10. *INVITED* "Fabrication of AlGaN/GaN/AlGaN Double Heterostructure HEMT on Diamond," Edwin L. Piner, 220th Electrochemical Society Meeting, State-of-the-Art Program on Compound Semiconductors 53 (SOTAPOCS 53) Symposium, October 9-14, 2011, Boston, MA, USA.
    11. *INVITED* "Integration of Gallium Nitride and Silicon: From Devices to Diamond," Edwin L. Piner, IEEE International Silicon-on-Insulator (SOI) Conference, October 3-6, 2011, Tempe, AZ, USA. DOI: 10.1109/SOI.2011.6081705
    12. *SEMINAR* "GaN-on-Si: Truth is Stranger Than Fiction," Edwin L. Piner, University of Bristol, July 18, 2011, Bristol, United Kingdom.
    13. *SEMINAR* "GaN-on-Si: Truth is Stranger Than Fiction," Edwin L. Piner, RWTH-Aachen – University of Aachen, May 26, 2011, Aachen, Germany.
    14. *INVITED* "GaN-on-Si HEMTs: From Device Technology to Product Insertion," W. Johnson, S. Singhal, A. Hanson, R. Therrien, A. Chaudhari, W. Nagy, P. Rajagopal, Q. Martin, T. Nichols, A. Edwards, J. Roberts, E. Piner, I. Kizilyalli, and K. Linthicum,

Materials Research Society Symposium; Advances in GaN, GaAs, SiC and Related Alloys on Silicon Substrates, March 24-28, 2008, San Francisco, CA, USA.

15. *INVITED* "Progress in GaN Electronic Devices and Timeline For the Completion of the Overriding Vision of GaN Electronics: A USA Perspective," Edwin L. Piner, 2007 Workshop on Compound Semiconductor Devices and Integrated Circuits – Europe (WOCSDICE), May 23, 2007, Venice, Italy, EU.
16. *INVITED* "Qualification and Reliability of a GaN Process Platform," S. Singhal, A.W. Hanson, A. Chaudhari, P. Rajagopal, T. Li, J.W. Johnson, W. Nagy, R. Therrien, C. Park, A.P. Edwards, E.L. Piner, K.J. Linthicum, and I.C. Kizilyalli, 2007 International Conference on Compound Semiconductor Manufacturing Technology (CS ManTech), May 15, 2007, Austin, TX, USA.
17. *INVITED* "Device Degradation Phenomena in GaN HFET Technology: Status, Mechanisms, and Opportunities," E.L. Piner, S. Singhal, P. Rajagopal, R. Therrien, J.C. Roberts, T. Li, A.W. Hanson, J.W. Johnson, I.C. Kizilyalli, and K.J. Linthicum, 2006 International Electron Devices Meeting (IEDM), December 11-13, 2006, San Francisco, CA, USA.
18. *INVITED* "GaN on Silicon For High Power and High Frequency Electronics," Edwin L. Piner, 2001 Workshop on Compound Semiconductor Devices and Integrated Circuits – Europe (WOCSDICE), May 29, 2001, Cagliari, Italy, EU.

3. Consultancies:
Consulting for two private companies working in III-Nitride materials and devices (2010 – present) and three legal firms as an expert regarding patent infringement in electronic materials and processing (2011 – present), semiconductor device fabrication (2015 – present), and plasma physics and applications (2014 – 2016).

- Lexington Luminance, LLC & Katz, PLLC, 2016-present
- Lite-On Technology Corp & Pillsbury Winthrop Shaw Pittman, LLP, 2023-present
- Confidentiality restricts publication of other entities

<u>Professional Services & Litigation Testimony, 2013-present</u>

*Technical Consultant*, Infineon Technologies, Austria, EU.

*TRUSTEES OF BOSTON UNIVERSITY v. EVERLIGHT ELECTRONICS CO., LTD. ET AL*, No. 12-cv-11935-PBS, 2013 U.S. Dist. Massachusetts.

*TRUSTEES OF BOSTON UNIVERSITY v. SEOUL SEMICONDUCTOR CO., LTD., ET AL*, No. 12-cv-11938-PBS, 2013 U.S. Dist. Massachusetts.

*TRUSTEES OF BOSTON UNIVERSITY v. EPISTAR CORPORATION*, No. 12-cv-12326-PBS, 2013 U.S. Dist. Massachusetts.

*TRUSTEES OF BOSTON UNIVERSITY v. LITE-ON, INC., ET AL*, No. 12-cv-12330-PBS, 2013 U.S. Dist. Massachusetts.

*TRUSTEES OF BOSTON UNIVERSITY v. SAMSUNG ELECTRONICS CO., LTD., ET AL*, No. 13-cv-10659-PBS, 2013 U.S. Dist. Massachusetts.

*TRUSTEES OF BOSTON UNIVERSITY v. AMAZON.COM, INC.*, No. 13-cv-11097-PBS, 2013 U.S. Dist. Massachusetts.

*TRUSTEES OF BOSTON UNIVERSITY v. ARROW ELECTRONICS, INC., ET AL*, No. 13-cv-11105-PBS, 2013 U.S. Dist. Massachusetts.

*TRUSTEES OF BOSTON UNIVERSITY v. APPLE, INC.*, No. 13-cv-11575-PBS, 2013 U.S. Dist. Massachusetts.

*TRUSTEES OF BOSTON UNIVERSITY v. HEWLETT-PACKARD COMPANY*, No. 13-cv-11832-PBS, 2013 U.S. Dist. Massachusetts.

*TRUSTEES OF BOSTON UNIVERSITY v. VYRIAN, INC.*, No. 13-cv-11963-PBS, 2013 U.S. Dist. Massachusetts.

*LEXINGTON LUMINANCE LLC, v. GOOGLE, INC*, No. 1:12-cv-12218-RGS, 2016 U.S. Dist. Massachusetts.

*LG INNOTEK CO., LTD., v. LEXINGTON LUMINANCE LLC*, IPR2017-00052, 2017 U.S. Patent Office.

*SAMSUNG ELECTRONICS CO., LTD., v. LEXINGTON LUMINANCE LLC*, IPR2017-00539, 2017, U.S. Patent Office.

*SAMSUNG ELECTRONICS CO., LTD., v. LEXINGTON LUMINANCE LLC*, IPR2017-00540, 2017, U.S. Patent Office.

*TCL CORPORATION, TCL MULTIMEDIA TECHNOLOGY HOLDINGS, LTD., AND TTE TECHNOLOGY, INC., v. LEXINGTON LUMINANCE LLC*, IPR2017-01780, 2017, U.S. Patent Office.

*NITRIDE SEMICONDUCTORS LTD. CO., v. RAYVIO CORPORATION*, No. 5:17-cv-02952-EJD, 2018 U.S. Dist. Northern California, San Jose Division.

*ACORN SEMI, LLC, v. SAMSUNG ELECTRONICS CO., LTD, ET AL.*, No. 2:19-CV-347-JRG, 2021 U.S. Dist. Eastern Texas.

*NITRIDE SEMICONDUCTORS LTD. CO., v. DIGI-KEY CORPORATION D/B/A DIGI-KEY ELECTRONICS*, No. 17-cv-4359 (JRT/LIB), 2022 U.S. Dist. Minnesota.

*NITRIDE SEMICONDUCTORS LTD. CO., v. LITE-ON TECHNOLOGY CORPORATION, LITE-ON TECHNOLOGY USA, INC., LITE-ON, INC., and LITE-ON TRADING USA, INC.*, No. 6:21-cv-00183-ADA-DTG, 2022 U.S. Dist. Western Texas.

*CRYSTAL IS, INC., v. NITRIDE SEMICONDUCTORS LTD. CO.*, Case No. 1:21-cv-606 (GTS/DJS), 2022 U.S. Dist. Northern New York.

*DAEDALUS PRIME LLC, v. SAMSUNG ELECTRONICS CO., LTD., SAMSUNG ELECTRONICS AMERICA, INC., SAMSUNG SEMICONDUCTOR, INC., and SAMSUNG AUSTIN SEMICONDUCTOR, LLC,* No. 2:22-cv-00353-JRG, 2022 U.S. Dist. Eastern Texas.

4. Workshops:

- 9th International Conference on Nitride Semiconductors (ICNS-9), "What is the Next Big Thing in III-Nitride Electronic Devices?" Workshop Panel Presenter, July 10-15, 2011, Glasgow, Scotland, UK. *INVITED*
- IEEE Microwave Theory and Techniques Society International Microwave Symposium (IEEE MTT-S 2010 IMS), "High-Power-Density Packaging of Gallium Nitride" Workshop Panel Presenter, May 23-28, 2010, Anaheim, CA, USA. *INVITED*
- 8th International Conference on Nitride Semiconductors (ICNS-8), "The Future of GaN Electronics" Panel Expert, October 18-23, 2009, Jeju, South Korea. *INVITED*

C. Grants and Contracts

1. Funded External Grants and Contracts:

2023-2027, Army Research Office HBCU/MI, "Lateral Heterogeneous Integration of Ultrawide

Bandgap AlGaN and Diamond," $800,000, E. Piner (PI) and M. Holtz

2021-2023, Texas Instruments – Dallas (Gift), "Kinetics of Defect Formation in GaN on Si Processing" $135,000 ($90k+$45k), E. Piner

2020-2021, Texas Instruments – Dallas (Gift), "MOCVD Growth of AlN on Silicon," $146,000, E. Piner

2020-2023, Army Research Office HBCU/MI, "Heterogeneous Integration of Diamond and Ultrawide-Bandgap Semiconductors for Fundamental Phonon and Electron Transport Studies," $660,000, E. Piner (PI) and M. Holtz

2020-2021, Texas State Univ REP, "Improving Thermal Management in GaN HEMTs via Simulation of TDTR Characterization," $16,000, E. Piner (PI) and L. Scolfaro (co-PI)

2018-2021, NSF EPMD, "Integrated Selective Growth of Diamond and GaN for Thermal Management," $410,000, E. Piner (PI) and M. Holtz

2017-2019, Army HBCU/MI, "Integrated Characterization of Electronic Devices and Materials for Research and Education" $332,086, J. Li (PI), and E. Piner, W. Geerts, N. Theodoropoulou, R. Droopad, T. Myers, M. Chen, Q. Yu, A. Zakhidov, M. Holtz, and C. Smith (senior collaborators)

2016-2017, Army HBCU/MI, "Scanning Probe Microscope for Materials Research and Education," $358,558, A. Zakhidov (PI), and T. Myers, B. Beall, E. Piner, W. Geerts, N. Theodoropoulou, T. Betancourt, and M. Holtz (senior collaborators)

2016, Army High School / Undergraduate Research Participation, "The Fundamental Science of GaN-Diamond Heterointerface Thermal Transport," $6,075, E. Piner (PI), M. Holtz (co-PI)

2015-2018, Army HBCU/MI, "Integrated GaN HEMT on Diamond: Heterointerface and Thermal Transport Fundamentals," $594,000, E. Piner (PI), M. Holtz (senior collaborator)

2014-2016, DARPA – GaTech/Univ.Bristol/Stanford/UCLA, "Thermal Transport in Diamond Films for Electronics," $300,000 – Year 1 + Year 2, M. Holtz (PI), E. Piner (co-PI)

2012-2014, DARPA / ONR / Texas A&M University, "Selective III-N Epitaxy Development," $197,971 (subcontract), E. Piner (PI)

2012-2013, Texas Instruments – Dallas, "GaN-on-Si(111) Epitaxy Investigation for 600V Demonstration," $120,000 (two performance-based contracts, $60k each – 1st award, April, 2012), E. Piner (PI)

2012, Texas A&M University TEES Grant for equipment acquisition of a Wafer Bonding System, $55,000, (with additional contributions of $80,000 University, $25,000 College, and $5,000 Physics Departmental funds to match), E. Piner (PI)

2011-2012, SEMATECH, "Unrestricted Grant – Research & Development Activities Related to GaN for Power Devices", $20,000, E. Piner (PI)

2011-2012, NSF – Major Research Instrumentation, "Acquisition of ICP-RIE Capability at Texas State University-San Marcos," $545,673, In-Hyouk Song (PI), and E.L. Piner, Hsing-Huang Tseng, Maggie Chen, and Byoung You (co-PIs)

2010-2011, Nitronex Corp / MDA-AFRL, "Novel HEMT Based on GaN on Diamond for High Power Amplifiers", PI, $170,000 (subcontract), E. Piner (PI)

D. Fellowships, Awards, Honors:

- 2022 The Graduate College's Doctoral Research Support Fellowship Award – Mr. Anupam K.C., PhD-MSEC.
- 2019 The Graduate College's Doctoral Research Support Fellowship Award – Mr. Rony Saha, PhD-MSEC.

- 2017-18 The Graduate College's Doctoral Research Support Fellowship Award – Mr. Raju Ahmed, PhD-MSEC.
- 2017 The Graduate College's Doctoral Research Support Fellowship Award – Mr. Anwar Siddique, PhD-MSEC.
- 2015 The Graduate College's Doctoral Research Support Fellowship Award – Mr. Jeffrey Simpson, PhD-MSEC.
- 2014 The Graduate College's Outstanding Master's Thesis Award in Math, Physical Sciences and Engineering – Mr. Jonathan Anderson, MS-Physics.
- 2014 Presidential Distinction Award for Excellence in Scholarly / Creative Activities, Texas State University, College of Science and Engineering, Physics.
- Best Paper Award, "New Technologies for Improving the High Frequency Performance of AlGaN/GaN High Electron Mobility Transistors," J.W. Chung, E.L. Piner, J.C. Roberts, and T. Palacios, International Conf. on Advances in Electronics and Microelectronics, 2008, ENICS '08, Sept 28 – Oct 4, 2008, Valencia, Spain, EU.
- Alpha Sigma Mu, Honorary Engineering Fraternity
- Government Assistance in Areas of National Need - Electronic Materials Fellow (1993 – 1997)

## IV. SERVICE

A. Institutional

1. University:
   IP Committee (2010 – present)
   University Leadership Assembly, COSE Representative (2015 – 2022)
   Big Ideas Initiative Director / Committee (2019 – present)
   University Curriculum Committee (2017 – 2022)
   CIEDAR (Connected Infrastructure, Education, Demonstration, and Applied Research) Working Group Member (2019 – present)
   STEM Workforce Advisory Council, through *Generación STEM* grant, Physics Representative (2022 – present)
   Graduate Council, Physics Representative (2019 – 2022)
   Special Assistant to the President, Research Center Development (2017 – 2019)
   Texas State Moonlight Breakfast (2010, Fall)

2. College:
   Microfabrication Lab Strategy Committee (2010 – 2011)
   COSE – Curriculum Committee, MSEC (2013 – 2022)
   Advanced Functional Materials-RSC Steering Committee – Chair (2014 – 2019)
   College Research Enhancement Committee (CREC) – Physics Faculty Representative (2014-2015 & 2016-2017)
   College of Education Tenure & Promotion Review Group (2014 – 2015)
   College of Science & Engineering Tenure & Promotion Review Group (2015 – present)

3. Department/School:
   Physics Faculty Search Committee (2010)
   MSEC-ETF Faculty Search Committee (2011 – 2012)
   MSEC-Physics University Chair Faculty Search Committee (2012)
   MSEC Committee of Committees (2011 – present)
   MSEC PhD Admission Committee (2012 – 2019)
   Physics Personnel Committee (2013 – present), Chair (2016 – 2022)

Physics Faculty Search Committee – Chair (2013 – 2014)
Physics Faculty Search Committee – Chair (2014 – 2015)
MSEC Engineering & Science Building Classroom Task Force (2016 – 2018)
Physics Faculty Search Committee (2016 – 2017)
Physics Faculty Search Committee (2017 – 2018)
Physics Graduate Advisor (2017 – 2022)
Physics Faculty Search Committee (Astronomy) (2018 – 2019)
MSEC Faculty Search Committee (EE) (2020 – 2021)
Physics Faculty Search Committee (Materials Physics) (2022 – present)
Physics Department Chair (2022 – present)

B. Professional:

- Transactions on Electronic Devices, Associate Editor. 2019 – present.
- *Member*, Central Texas Regional Center of Innovation & Commercialization (RCIC) Advisory Board. (Advisory Board members support the review process of the Texas Emerging Technology Fund by providing expertise, industry sector perspective and support to the Central Texas RCIC Board.) 2014 – present.
- *Senior Member*, The Institute of Electrical and Electronics Engineers (IEEE)
- *Member*, Materials Research Society (MRS), and Electrochemical Society (ECS)
- WOCSDICE – Workshop on Compound Semiconductor Devices and Integrated Circuits – Europe. *Member – International Advisory Committee*, 2012 – present.
- EMC – Electronic Materials Conference, USA. *Member – Technical Advisory Committee*, 2012-present.
- ESSDERC – European Solid State Device Conference. *Technical Program Committee* 2014 – present.
- Scientific Journal Reviewer:
    - IEEE Electron Device Letters
    - IEEE Electronics Letters
    - IEEE Transactions on Electron Devices
    - Physica E
    - Solid State Electronics
- NSF Electronic & Photonic Materials CAREER Panel, October 2018
- NSF Electronic & Photonic Materials Panel Review Team, January 2017
- NSF Electronics, Photonics & Magnetic Devices Panel Review Team, April 2015
- NSF Electronic & Photonic Materials Panel Review Team, February 2012
- NSF Electronic & Photonic Materials Panel Review Team, January 2011
- State of Texas Expert Review, end of year testing STEM questions review – Lone Star Assessment & Publishing, and Pearson Publishing, Austin, TX, December 2010
- North Carolina State University, Materials Science and Engineering Department, 2008-2009 Senior Design Project; Presentation and Final Paper Panel Judge, April 24, 2009.

C. Community:

- 2016-2017 – New Braunfels High School Independent Study and Mentorship Program, Mr. Jake Ables, Topic: Superconductivity.
- 2016, February – San Marcos Area Chamber of Commerce, Education Advisory Board Meeting. Invited to discuss US Army Education Outreach Program for High School STEM Research Apprenticeship Program.

- 2016, February – San Marcos High School. As follow-up to CoC Education Advisory Board Meeting, invited to discuss US Army Education Outreach Program for High School STEM Research Apprenticeship Program to two teachers and their classes.
- Texas Nitride Network – Founding Member (organization consisting of Texas A&M, Texas Tech, SEMATECH-Austin, and UT-Dallas for coordinating research and funding pursuits)

D. Service Honors and Awards:

- Alpha Sigma Mu, Honorary Engineering Fraternity
- Engineers Council, NCSU Student Government (1993)

Updated 08/2023